Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Engineering 28 (2012) 677 – 682

Procedia Engineering

www.elsevier.com/locate/procedia

2012 International Conference on Modern Hydraulic Engineering

Research on Prospect and Problem for Hydropower Development of China

LI Jia-kun, a*

Changjiang Engineering Vocational College, Wuhan, 430212, China

Abstract

The development of new energy has become a focus of global concern under the climate change. In this paper, on the basis of the status quo on the hydropower development of China, it is discussed the significance of the priority development of hydropower energy, and analyzed the current main problems of hydropower development in China. The corresponding measures of scientific development of hydropower energy were also proposed, such as the priority to the development of hydropower, vigorous promotion on the rural small hydropower, reasonable solution to the immigration problem. In order to promote the comprehensive and sustainable development of economy and society, it is necessary to innovate and develop proper pattern of hydropower exploitation. In addition, eco-environmental conservation should also be paid more attention.

Keywords: Hydropower energy; hydropower resource; small hydro power; hydropower development; science development

1. Introduction

Energy is a major strategic issue that concerns the overall social and economical development. Hydro energy is a very important part of china energy, but the development and utilization rate of our water resources development is relatively low [1]. So, actively planning the development of hydroelectric energy, handling the major relationship of the hydropower development properly, resolving the key and difficult problems in the current hydropower development, and promoting a comprehensive, coordinated and sustainable development of hydroelectric energy are the imperative needs of meeting the rapid development of the national sustained economy.

* Corresponding author. Tel.: 13554338496.
E-mail address: cjljk@163.com.

 doi:10.1016/j.proeng.2012.01.790

2. The prospects of hydropower development in China

2.1. The current situation of hydropower development in our country

Hydro energy is a renewable clean energy, and China's abundant hydropower resources is the highest in the world [2] .According to the reviewed results of national water resources that published in 2005, the theoretical potential annual generation capacity of water is 6.0829 trillion kW • h, China's explored installed capacity of hydropower technologies is 378 million kilowatts, equivalent to 1.92 trillion kW • h, which is the 1 / 5 of the total capacity and is ranked the first in the world.

The distribution of developable hydropower potential in each province is uneven geographically. Southwest accounts for 61.4% of the total resource, 17.8% and 11.2% separately for middle south and Northwest, East accounts for 4.7%, 3.1% in Northeast and 1.8% in North. Obviously, the hydropower development of china is mainly concentrated in the southwest.

Since the early 20th century, China has started on the hydropower development. In 1912, the first hydropower station, the Shilong Dam, was built in Yunnan, and the hydropower installed capacity was only 0.48MW [3]. Now the total capacity of hydropower's economy in China could be achieved at 400 million kilowatts. Water resources of China will be account for 40% of the reserves of workable conventional energy sources [4] if being re-used in 100 years. By the end of 2008, the hydropower installed capacity that has been built was nearly 172 million kilowatts, and the annual hydropower generation capacity is 563.3 billion kW • h , which is count for the 18.5% of the total.

2.2. The meaning of take precedent of developing hydropower resource

Hydropower occupies a pivotal position in China's energy structure and it is the foundation to achieve the comprehensive, coordinated and sustainable economic and social development. In terms of the conventional energy reserves and energy savings, hydropower is the inevitable choice to optimize our country's resource structure by transiting from high polluted fossil fuels to clean renewable energy.

China's unreasonable energy consumption structure is particularly evident in the world, the coal consumption in the total energy consumption is much higher than the proportion of the world average, and the highly dependence on coal energy structure has led to serious air pollution problems [5]. Especially those small coal-consumed electricity generating units which are of high-volume coal consumption, low efficiency, and severe pollution. On the other hand, the development of hydroelectric energy will bring many benefits, such as speeding up the reconstruction of the power, turning off the small coal-consumed electricity generating units, reducing air pollution and energy consumption. Meanwhile, exploiting a great quantity of fossil energy materials will lead to surface subsidence and crack, the destruction of groundwater resources and ecological environment.

Although the development of hydropower can also bring out some environmental problems, but it is a clean energy and will not pollute the atmosphere. Compared to the coal and electricity, it brings smaller combined effects to the environment, and we should also give priority to the development of hydroelectric energy by concerning the environment protection.

Due to the natural limits, China's western region which is rich in hydropower resources, were confronted with multi-task which were economic development, getting rid of poverty, protecting the environment and sustainable development[6]. We should be actively converted the resource advantages to economic and development advantages by giving priority to the development of hydropower, promoting regional socio-economic sustainable development, narrowing the gap between eastern and western regional economic development, and increasing the local farmers' income. As a renewable energy which can be developed in large scale, to speed up the development and utilization of hydropower resources

under the condition of protecting the ecological environment and properly solving the immigration problem is an important way to solve our energy requirement. Increasing investment in hydropower can effectively stimulate domestic demand, benefit the steel, cement and other building materials manufacturing industries, as well as the employment of an abundance of construction workers.

The development of hydropower is not purely an energy problem; it is generally associated with the implementation of flood control and optimal allocation of water resources. In the hydropower development, one of important goals is about management of river flooding and the insurance of life safety and property. By building dams and large reservoirs, the river discharge can be regulated with huge storage by months, years or even years. Redistributing nature water and reserving water when the runoff abundant and supply water when runoff drying, which can not only increase downstream flood control standard defense objects, but also can improve water use efficiency, the ecological environment of the downstream estuary, reduce the number of drying, thereby ensuring integrated watershed improving efficiency.

China's over-reliance on coal energy consumption structure has caused serious environmental problems, which is not a sustainable energy consumption pattern. As a renewable energy which can be developed in large scale, it is an efficient way to achieve the improvement of the source structure and the protection of ecology environment. To some extent, it also can solve the power shortage in China, promote comprehensive utilization of water resources, adjust the industrial structure, promote the sustainable development of the regional economy and narrow the gap of economic development between east and west. Therefore, the change of energy production and consumption patterns, increase the hydropower and other renewable energy sources in the proportion of the energy mix, achieve the diversification of the resources and power structure, is an important part of China's sustainable development strategy.

China has lots of rivers, and the hydraulic power storage ranks first in the world [7]. Until now tens of thousands of hydropower stations have been completed, including the Three Gorges, Longtan power station. The installed capacity reaches 170 million kilowatts, the annual electricity amounts 560 billion kW • h, the construction scale achieves about 70 million kilowatts, ranking first in the world [8]. The hydropower accounts for 21.6% of the country's total electricity, which supplies a large number of clean electricity to the development of economy and society. Besides, China's small hydropower resources in technology development amounted to 128 million kilowatts, also ranking first in the world, which has tremendous potential for development.

In recent years, with the change of world energy pattern, China also adjusted the energy policy and increased hydropower development efforts. With the start of large hydropower projects, some engineering problems have been resolved in practice, thus the difficulty of water resources development in remote areas is also greatly reduced. From the summary of various countries' experience in the development of energy, it was not hard to see that give priority to the development of hydropower energy may be an effective way to the energy development. Whether the countries which are rich in water resources, such as the United States, Canada, Brazil, or poor in water resources, such as France, Japan, they are all take precedence to develop hydropower. On the base of the previous successful construction experience, we should seize the opportunity to ease the tensional power supply and make contribution to our country.

3. The analysis of several problems on the development of hydropower

3.1. The risk and place of hydropower development

The advantage of Hydropower is clean energy, renewable, non-polluting, low operation cost, and easy to power peak shaving, but its disadvantages are as followings: large project investment, long

construction period, and rich long-term effective and poor short-term benefit, slow investment recovery. Compared with thermal power in per kilowatt cost, hydropower is about 7,000 to 10,000 yuan per kW, thermal power is about 5400 ~ 6300 yuan in 30 with 60 million China-made set, thus hydropower is about 40% higher than thermal power. What's more, influenced by seasonal factors and the transmission distance , hydropower water cost is about one times as much as thermal power in per kW ; In the terms of start-up date, generally the hydropower station can stop flow in the second year, the first generating unit puts into operation in the fifth year, then put one another semiannually; thermal power station of power plant 30 million kW has to spent on preparation about six months to one year, the first generating unit puts into operation in the third year, with the second one 10 months after. Large-scale hydropower investors get capital gains generally after 7-10 years, so the risk of investment in hydropower is obvious.

However, due to hydropower stations has a flood control, navigation, water supply, irrigation, tourism and other comprehensive benefits, what's more, it need not consume valuable coal, oil and other non-renewable resources and will not cause environmental and air pollution, so the world are all give the priority to the development of hydropower even though it can cause issues such as submerge land , immigration, and ecology change , , China is a huge hydroelectric country with huge development potential, so hydropower development should be placed in priority status in the future.

3.2. The good and bad influence of the hydropower resource development

Hydropower development will lead to favorable or adverse effects on the local development and the environment. Firstly, hydropower is the renewable energy which can be exploited commercially, so accelerate the development of hydropower will help to improve our electric power industry structure. Meanwhile, the hydroelectric power also has the comprehensive benefits of improving power quality; flood control, agricultural irrigation, industrial water supplement optimize the allocation of water resources and so on. On the other hand, hydropower development will lead to ecological and environmental protection issues, such as resettlement, sedimentation, the effect on the fish and biodiversity, and the change of land and cultural relics submerged, physical phenomena on the up and downstream, which were caused by Construction of Hydraulic and Hydroelectric Projects need to be properly addressed.

3.3. Immigrants problem

Because of lacking investment and other conditions, some projects focuses on the development of project construction and not take a long-term point of view about the immigrants in the hydropower development area, so it will causes the instability because of many immigrants lost their lands and did not have the condition to maintain their livelihood. The next step the station will pay attention to the continued safety of the immigrants with the introduction of relevant national measures. At the same time, the idea of hydropower development should be changed; our country should put the hydropower development and improvement of living conditions of immigrants closely together. The future hydropower development should focus on this theme that Hydropower development must arrange immigration prior to construction, and make immigrants gradually get rich.

4. Measures

4.1. Take precedents of the development of hydropower

China will reach the economic level of the moderately developed countries in 2050 and the energy

demand will be 1.5 billion kilowatts. The Utilization of hydropower development in China is only 21.0% at present, which also has great potential. Therefore, it is entirely correct and necessarily to take a great effort to give priority to hydropower development. By 2015, conventional hydropower installed capacity will reach 271,000 MW, accounting for 28.6% of total installed capacity of electric power, the level of development will be up to 50%; And by 2020, conventional hydropower installed capacity will reach 328,000 MW, accounting for total power generating capacity of 28.5 %, the degree of development will reach 60%.

4.2. The development of small hydropower in rural places

The small hydropower resources in china is abundant and the distribution areas are wider, So the development of small hydropower in rural areas can not only earn great economic benefits, support the modernization of China's rural areas, but also can access huge environmental benefits, social benefits, and can prevent the transfer of environmental pollution from cities to the countryside. More than 1500 mountain counties in the total 2400 counties have water resources, By the end of 2008, 45,000 rural hydropower stations have been built, with a total installed capacity of 51 million kilowatts, the annual generating capacity is more than 160 billion kW • h, which is accounting for 30% of the nation's hydropower installed capacity and annual energy production, and its about 1/3 of the world's small hydropower capacity, and ranking first in the world. The rapid development of China's rural hydropower has great potential and broad prospects.

4.3. Reasonably resolve the immigrants' problem

The solving of the immigration problem lies in two points, firstly, we should organize planning and consummate system, put the river basin planning and the unified dispatch of watershed into effect, and focus on the ecological environment, the returns of investment, and the public participation; secondly, hydropower development is able to push forward in the immigration issue by transferring the simple way of financial compensation, promoting the reformation of changing the land rights in to capital investment, and protecting the rights of immigrants.

5. Conclusion

By studying the prospects and problems of the hydropower development, the author believes that we should stick to the people-oriented principle, update hydropower development concepts, and innovative hydropower development model; seriously treat and properly handle the hydropower development issues to promote sustainable development of economic and social; develop water resource with the harmony of nature and human, put the construction of power plant and ecological environment in the same important role.

References

[1] Yang Ping. Research of Sichuan Hydropower Resources Development Based on Low-Carbon Economic Model [J]. Ecological Economy, 2010, 24 (10) :100-103.

[2] Xu Changyi, Zhong Denghua, Cao Guangjing. Thoughts on Sustainable Development of Hydropower Resource in China [J]. Resources and Environment in the Yangtze Basin, 2008, 17 (4) :535-538.

[3] Du Zhongming, Wu Yun, Tong Mingdong, *et al*. Southwest Water Resources Development Status and Problems [J]. China

Power, 2008, 40 (9) : 12-16.

[4] Zhang Boting. Water conservancy and hydropower construction and a new round of western development [J]. Grid and clean energy, 2010, 26 (10) :1-5.

[5] Zhi Yong Han, Zhang Guoxiang. Under the guidance of scientific concept of development of hydropower development policy research [J]. Hydropower, 2008, 34(3) : 1-4.

[6] Huang Qiang, Wang Ruijun，Shen jin. Models and methods of planning in hydroelectric energy system [J]. Water Resources and Water Engineering, 1995, 6 (4) :1-10.

[7] E. A. Baltas, M. C. Karaliolidou. Land Use and Climate Change Impacts on the Reliability of Hydroelectric Energy Production [J]. Strategic Planning for Energy and the Environment, 2010(4).

[8] Chen Liuqun. Building a Modern Energy Source Industry System of Safety, Stability, Economy and Cleanness [J]. Hydropower and New Energy, 2010 (5):72-78.